JPRS: 2322

4 March 1960

CHINA'S ACHIEVEMENTS IN MICHURIN GENETICS DURING THE PAST DECADE

- COMMUNIST CHINA -

By Liang Cheng-lan

Distributed by:
OFFICE OF TECHNICAL SERVICES
U. S. DEPARTMENT OF COMMERCE
WASHINGTON 25, D. C.

~~Price: $0.75~~

U. S. JOINT PUBLICATIONS RESEARCH SERVICE
205 EAST 42nd STREET, SUITE 300
NEW YORK 17, N. Y.

JPRS: 2322

CSO: 3302-N

CHINA'S ACHIEVEMENTS IN MICHURIN GENETICS DURING THE PAST DECADE

[This is a translation of an article written by LIANG Cheng-lan, appearing in Sheng-wu-hsueh T'ung-pao (Biology Bulletin), No 10, 2 October 1959, pages 462-467.]

This is the tenth year of the establishment of our State, and it is also the tenth year in which great progress has been made in politics, economics, and in all kinds of construction enterprises. During the past decade, under the guidance of the Communist Party, scientific work has advanced to a degree never before achieved.

Michurin's advanced theory has been widely disseminated and developed since the liberation of the whole nation.

It is difficult for a new theory to gain any headway under the dominance of bourgeois ideology, for it is impossible to avoid obstacles which may attend the initial promotion of a new theory. However, since Michurin's theory is of a highly scientific and ideological nature, and since it is closely associated with production and the guidance of production, it can, therefore, also aid in raising the ideological level of technicians during their period of self-reform.

Thus, it is possible for Michurin's theory to take root and produce results among the broad masses in the rural areas and among the majority of the agronomists, biologists, and geneticists. Much has been accomplished in research and in the practical application of Michurin's theory during the past decade.

(1) Individual Development

The basic point of discussion in the Michurin theory is the principle of unity between all living things and their environment, for no living things can be cut off

from the required conditions for its existence. "External environmental conditions will influence the organic forms of all plants, animals and micro-organisms. Sooner or later these forms will adjust and be reconciled to these external influences exerted upon their condition of existence." (Lysenko)

Those who refuse to acknowledge this objective law and those who try to shatter this proof of unified relationship between all living things and their environment, are naturally considered to be wrong, as they are considered to be in opposition to the viewpoints upheld in biology.

The principle of individual plant development proves to be one of the main issues for discussion in the Michurin theory. Scientists in our nation have contributed a great deal in the control of plant development and in the supply of scientific material.

The Laboratory of Genetics, Academia Sinica, and the Jua-pei Agricultural Research Institute from 1953 to 1956 combined their efforts in the analysis of the vernalization (ch'un-hua) phase of each of 608 strains of wheat at their disposal. Of these, 292 strains of wheat seed were passed through the photo-phase. From this experiment it was ascertained that strains which had orginated further north were more hardy, while seed which had originated further south were spring type in nature.

With the northern latitude of 33 degrees serving as the demarcation line, it was determined that all strains of wheat seed originating south of this line would generally vernalize at a temperature of 0-12 degrees centigrade and that a period of 12-36 days would be required to complete the vernalization phase. To the north of this line of demarcation vernalization of seed would occur at a temperature of 0-7 degrees centigrade, and this would require a period of 36-51 days.

However, it was found that even though seed came from the same region, a higher altitude would produce winter type seed and a lower altitude would produce spring type seed. For instance, spring type seed si found along the coast line of Kwangtung and Fukien provinces, where the altitude is at sea level, but seed taken from the hilly or mountainous parts of these same provinces are of the winter type. Although Yunnan and Kweichow provinces are situated in the lower (southern) latitudes, yet because of the high altitude of that region, autumn sown wheat from that area is of a semi-winter or winter form.

The length of daylight time require for wheat to develop in each region bears a close relationship to the

length of daylight time the wheat received in its place of origin. Generally, when southern seed has been subjected to a reduction of temperature and light, its reaction is less sensitive than otherwise. Plants undergoing eight hours of daylight ear only 26 days later than plants treated continuously with daylight. However, under similar conditions winter forms delay earing by 62 days. Usually a period of 24-28 daylight days is necessary for the development of plants grown to the south of 33 degrees latitude, while to the north of 33 degrees latitude a period of 28-32 daylight days is required.

From 1953 to 1955 TSUI Chi-ling experimented at the Hua-tung [East China] Agricultural Research Institute and analyzed the vernalization phase of 104 strains of wheat grown in East China. Results gathered from his experiments were similar to the above principle. It was found that to the south of isotherm four degrees centigrade, during the month of January (e.g., in Wenchow), the seed were mostly spring forms. Between minus two and zero degrees centigrade (north of the Huai River) the seed were mostly winter or semi-winter forms. When treated with a short period of daylight, the reaction of seeds from the south was sluggish, while seeds from the north reacted much more sensitively.

During 1956-1958, LI Tse-i and others of the China Academy of Agricultural Sciences experimented with four different forms of winter wheat seed, and research on the development of wheat under controlled environmental conditions was done on a farm in Peiping. In the course of this experiment it was discovered that the "Ts'ao-yang-mai" [Early Foreign Wheat], a comparatively hardy form of winter wheat, was able to complete the vernalization phase before the onset of winter. Thus this seed could be sown earlier, enabling it to strat the daylight phase sooner.

The "Nan-ta No 2419", a semi-winter form seed, can even undergo the daylight phase before the onset of winter. However, regardless of what phase the plant is undergoing all development will cease during the winter season. Development will only continue during the following spring when the temperature is above zero degrees centigrade.

Each region has further proven the fact that seeds that have already germinated pass through the vernalization phase at a comparatively faster pace than seeds which have not germinated. Therefore it was acknowledged that nutrients produced and stored in the germinating seed can expedite the process of development.

Thus according to the theory of phasic development, the formation of any organ or of any characteristic in a plant must progress through determined phases of development. It is clear that the application of this principle is of great use in controlling the development of organs in the plant body.

The combined research done by the East China (Hua-tung) Agricultural Research Institute during 1953-1955 and by the Laboratory of Genetics during 1954-1956 has indicated that when the phase of vernalization is incomplete, spikelets on the stalk do not undergo any change. The tip of the stalk will start to grow and extend in length upon entering the photo-phase or daylight phase and proceed to grow by division. The second "leng" phase signifies the end of the photo-phase or daylight phase.

HSIA Chen-oa of the Institute of Plant Physiology, Academia Sinica, (1955) and HUANG Hung-shu of Chung-shan University (1957) both acknowledge the fact that the sudden appearance and continued development of stamens and pistils are evidence of the end of the photo-phase.

Experiments conducted by WU Lan-p'ei during 1954-1958 at the Peking University of Agriculture proved that light received by the plant during early morning and evening daylight hours causes slower development of flowering than light received during the noon hour. However, after inflorescence the daylight hours of the early morning and evening induce earlier earing. This shows clearly that the quality of daylight required during each developmental phase is not the same.

In 1957 T'SUI Ch'eng of Nankai University conducted research work on the effects of microscopic amounts of elements on the phasic development of wheat. During the course of research it was discovered that copper, zinc, molybdenum and borax can promote the development of wheat. Manganese and iron have no positive effect; in fact they may even exert a delaying effect in the development of wheat.

The Institute of Plant Physiology, Academia Sinica, and the East China Agricultural Research Institute cooperated in their research work on the phasic development of rice. It was found that rice seed would generally vernalize at temperatures between 15-30 degrees centigrade. This period of vernalization would last no longer than 12 days. A late rice crop must strictly adhere to a short period of daylight. A wider scope for adjustment to daylight is given to an early rice crop. A mid-season

rice crop comes between these two types of rice. It was also observed that when late rice crop ("Che-fang" No 9) was subjected to a short period of daylight after passing through the vernalization phase it required only 28 days to develop as compared to the 180 days previously needed.

During 1955-1956, WU Kuang-nan experiment at the East China Agricultural Research Institute with 831 strains of rice gathered from every part of the nation in order that estimates could be made of the reaction of different types and strains of rice to the length of daylight time required for development. It was observed that the characteristic reactions of the different strains of rice were related to the natural conditions found in their original habitat. For instance, in more northerly latitudes or at greater distances above sea level, or, if it is of the early maturing type, a seed's reaction towards light will be weaker than usual. If the conditions are reversed the reaction will be much stronger.

In 1953 YEH Hsiao and others experimented with 20 different kinds of grain seed from North China at the Laboratory of Genetics, Academia Sinica. From their experiments it was observed that a temperature of 13-21 degrees centigrade and five-seven days were required for the vernalization phase. Each type of seed demonstrated sensitivity towards light. The group of seeds which had been subjected to less than nine hours of light was the earliest to ear.

Earing was much delayed in the group of seeds which was subjected to more than 18 hours of light. Different characteristics were found in the seed types, and these characteristics were related to the latitude and to the height above sea level of the original habitat of the seed.

CHENG Wan-chen and CHEN Shan-pao proved in 1957, at the Laboratory of Genetics, Academia Sinica, that the chief differences observed in the early maturing corn and late maturing corn were in the slow response of the former towards light and temperature and the qucik response of the latter.

The Institute of Plant Physiology and the Laboratory of Genetics performed experiments on "Lu-ti" cotton and "Chung" cotton in order to analyze the vernalization phase of cotton. It was observed there was a short vernalization phase. The earlier maturing cotton crop required a period of five to seven days and the late maturing

cotton crop seven to eight days to head out into bolls. This would result in the early flowering of the plant before the onset of frost.

CHEN Ying, Laboratory of Genetics, and WU Hsieh-k'ang, North China Agricultural Research Institute, pointed out from their analytical work on the photo-phase of cotton that kapok (mu-mien) requires a strict adherence to a short period of light. No reaction could be obtained from "Ts'ao" cotton. The late maturing "Lu-ti" cotton is more sensitive to light than the early maturing cotton plant. During 1954-1955, the East China Agricultural Research Institute proved that "Lu-i" cotton and kapok from Fukien Province should be subjected strictly to a short period of light exposure. All other varieties of "Lu-ti" cotton and "Chung" cotton did not respond as sensitively towards light.

T'UNG K'o-chung, CHANG Ta-k'uei, and others working at the Laboratory of Genetics in 1954-1957 discovered while analysing the early maturation nature of cotton, that if the late maturing seed "Tai" No 14 were exposed to a long period of light budding would be much delayed, while the especially early maturing seed "Pa-wang-pien" was not delayed in budding. The late maturing seed, "Tai" No 14 could only bud at temperature above 20 degrees centigrade, while the especially early seed would bud below 19 degrees centigrade. There is a middle maturing seed between these two types, therefore it is felt that , in order to develop early maturing seed, measures should be undertaken to change the degree of sensitivity of the seed towards long periods of light and low temperatures.

CHAO Tsung-tao and P'EI Hsin-shu, from the Hunan Agricultural College, discovered in their research work during 1953-1956 that China grass or ramie fibre requires 54-55 days of short periods of daylight to enable it to flower early after germination. However, if the shoots which have sprouted from the stalk underground are taken up from the ground and subjected to light and warmth, it would hasten the results.

In 1956-1957, TANG Hsi-hua experimented on the development of jute at the Institute of Plant Physiology. He demonstrated that jute will flower much earlier if it is treated with light for ten hours, and that this photo-phase requires a period of three to four days to be completed.

At Chung-shan University, YU Chih-ch'en pointed out in 1958 that the photo phase of Indian jute required

a period of 10 days; the "Tung-kuan-yuan-kuo," 12-15 days; and the "Hsin-hsuan" No 1, a period of 18-21 days. It was further pointed out that in order to avoid early flowering it was feasible to select a suitable locality in that particular region for sowing the seed, bearing in mind at the same time the special requirements of the plant for its development during the photo-phase.

Research on foreign hemp (yang-ma) was done by HSIAO Fu and SHEN Tsung-tan, Chekiang University, in cooperation with CHEN Ying and others from the Laboratory of Genetics. They were able to show that budding and the development require a short period of daylight. Approximately 20 days of short daylight time were required for the appearance of buds. However, a period of 30 days of short daylight time was essential to prevent the premature dropping off of the buds.

In 1957 MENG Ch'ing-hsi experimented upon soybeans obtained from various parts of the country. His experiments showed that soybeans from the northern part of Northeast China responded weakly to short periods of light exposure. It was found that there was almost no variation in response to light resulting from the length of time to which the plant had been exposed, whether the time limit was 10 hours or whether the plant had been continuously exposed to daylight. However, in contrast, soybeans from Fukien and Kwangtung Province required approximately 9-12 days in which to complete their development during the photo-phase.

T'ANG Yu-wei, CHIN Cheng-chung, and others have conducted research on vegetables. For instance, on the phasic development of the leafy vegetable "T'an-k'uo-tsai," CHANG Pang-chieh and CHING Shih-hsi demonstrated the possibility of planting "Pai-t'sai" and white radish seeds during the same year if the seed had been pre-treated by the vernalization process. LI Shu-hsien of Chekiang University observed in 1954 the conditions required for the development of garlic. Garlic would require a period of 20-30 days of low temperatures ranging from zero to four degrees centigrade before it would be able to bring forth shoots. However, since garlic must also pass through the vernalization phase, a long period of exposure to light is necessary for it to develop properly.

TS'AO Tsung-sun of Peking University discovered in 1957 that under the influence of certain changes in environmental conditions (nutrients, amount of moisture in the soil, etc.) the ratio of stamens to pistils in the cucumber plant is somewhat changed. It was pointed

out that adaptation to external changes in the environment will change the metabolic pattern of the plant. Therefor it is entirely possible to control the sex determination of the plant.

The above-mentioned results not only provide evidence for the theory of the inseparable unity of the organism with its environment, but also provides scientific material for research work in the selection of seeds, the development of seeds in a pre-determined direction, and the introduction of new seeds.

(2) Vegetable Hybridization in Animals and Plants (Asexual Reproduction)

Vegetative hybridization is an important part of the Michurin theory of genetics. Not only has this theory opened up a new method for the selection of seed, but it has also indicated and demonstrated the means by which the hereditary and variable natures of plants can be recognized.

Morgan's school of thought accepts as a fact that there is a distinct substance within an organism which has the special function of heredity, that the general body of the organism is but a by-product of this heredity substance, and that the constituents in the body of the organism cannot basically affect it and are therefore unable to change its hereditary nature.

There is a great deal of material to provide the proof of vegetative hybridization and this material will provide the right arguments to refute Morgan's type of incorrect theoretical thought.

During 1949-1950, under the guidance of the Michurin theory, YEN Chi and HO Wen-chün experimented at the Southwest Agricultural College with a red tomato variety, the "Ta-hung," using it as the stock. The "Yellow Queen," a yellow tomato variety, was used as the scion and grafted onto the "Ta-hung" stock. The fruit produced on the parent branches after grafting were two red-spotted tomatoes from the "Ta-hung" variety and two yellow tomatoes from the "Yellow Queen" variety. However, the progeny of the F1 generation from the scion produced yellow fruit with red stripes, and from the stock, red fruit with yellow stripes. This clearly demonstrates the fact that in grafting there is a mutual

assimilation of the special characteristics from both the stock and the scion which in turn produce a vegetative hybrid.

During 1951 to 1953 CHEN Hsiu-fu of the Peking Agricultural University grafted the yellow tomato "Lo-ti-huang" onto a red tomato plant, the "Ko-li-ou." Fruit produced from this grafting was orange in color. The F1 generation resulting from this seed produced three varieties of tomatoes: (1) Red fruit (similar to stock); (2) Yellow fruit with red stripes (an intermediate type); and (3) Yellow fruit (similar to the scion). The F2 generation produced a fourth type of hybrid tomato. This was a red-topped yellow fruit.

The researcher then grafted a round-shaped "K'o-li-ou" tomato onto a peachshaped "Hung-t'ao" tomato in order to train a peach-shaped hybrid variety. The F1 generation bore fruit which were peach-shaped and another type which seemed to be an intermediate-shaped fruit. Besides this it was discovered that both round and peach-shaped fruit were produced on the same branch.

SHEN Te-hsü of the Chekiang University Agricultural College experimented during 1950-1953 with a small cherry-shaped fruit, "Chih-pao-shih", using it as the stock onto which the scion "Huang-mei", a light-yellow persimmon-shaped fruit, was grafted. The F1 generation produced the following types of fruit: (1) large light yellow fruit; (2) fired-red small medium-sized fruit, an intermediate type; and (3) fiery-red large-sized fruit. This last fruit is the color of the stock and the size of the scion. There were many more varieties in the F2 generation.

At the North China Agricultural Research Institute, TSU Te-ming and CHAO Yü-sheng experimented during 1951-1953 with "K'a-te-ta-hung", a red fruit, using it as the stock and with "Lo-ti-huang," a yellow fruit, as the scion. The scion was grafted onto the stock in order to effect a change in the scion, and repeated grafting was done during the next two generations. Then the progeny of the seed taken from the scion produced two varieties of fruit, a red and a yellow. The progeny from these two varieties produced a third, an orange colored fruit in addition to the original red and yellow fruit. This orange color fruit is obviously an intermediate type.

It was interesting to note, however, that this experiment does not follow Morgan's school of thought. Morgan's theory stated that the segregation of recessive characteristics can only happen in a plant manifesting the dominant characteristics. In this experiment, a plant,

bearing recessive characteristics of yellow fruit, was able to produce another plant carrying the dominant characteristics of red fruit.

The Biology Department of Amoy University carried out an experiment in grafting plants from two different species. The yellow tomato plant, "Huang-li," was used as the scion. It was grafted onto the stock, "Teng-lung La-chiao," a large green pepper plant. It was found that the seed generation from the scion tomato plant produced a fruit much larger in size and was of an orange-reddish color. The ovule compartments in the fruit were also increased. Interestingly enough, other varieties do not bear fruit in this region, because the flowers from the plants drop off too early to be able to bear any fruit. This hybrid, however, could even bear fruit in the summer. At present more research work is being carried out to develop more of this kind of hybrid plant by means of the segregation method.

CHEN Hsiu-fu did some experiments during 1951-1954 in grafting a round red tomato plant onto a white-skinned potato. No conspicuous changes were observed in the first two generations, but in the seed of the F3 generation a great change was noticed. The fruits produced were red and pink in color and of all sizes ans shapes, ranging from flat to round-shaped. But the most noticeable characteristic in this crop was a yellow round-shaped fruit, representing a new hybrid variety. It was also noticed that the length of time required for the fruit to ripen was very different from either of the parent plants.

Equally great changes in the asexual reproduction of different species as a result of grafting were also observed at the Kwangsi Agricultural College. A tomato plant was grafted onto the stock Lysium Chinese [a kind of aspen]. There were no appreciable changes in the F1 and F2 generations of the seed progeny, but in the F3 generation many changes were observed. In form the fruit was similar to the orange, plum, persimmon, apricot, date, peach, and pear. There were some irregularly shaped forms due to the irregular development of the petals. The fruit exhibited a wide range of colors: crimson, orange, red, yellow, and mixtures of all these.

CHOU K'o-yung of the Fukien Agricultural College conducted some experiments on the cotton plant. He observed that when the smooth cotton-seed plant, "Chung-mien," was grafted onto the hairy cotton-seed plant, "Lu-ti" cotton plant to effect a change in the nature of the latter, the seed resulting from the graft was still hairy.

However, the progeny from this hairy seed produced smooth cotton seed, and in the F2 generation all the seeds were smooth.

CHI Tao-fan and T'UNG K'e-chung experimented further on the cultivation of hybrid cotton from "Chung-mien" and "Lu-ti-mien". They discovered that when "Lu-ti-mien" was grafted onto "Chung-mien", the cotton resulting from this graft ripened six to seven days earlier than the original "Lu-ti-mien." When "Chung-mien" was grafted onto "Lu-ti-mien," the ripening period was delayed. The above results clearly demonstrate the effect of "training". For "training" is the action of appropriate external conditions directing the development of the progeny in the direction of the inducing environmental factor.

During 1955-1958, CHEN Hsiu-fu and CHANG K'ung-i experimented with various combinations of grafting. During the course of their experimentation with a tree form of cotton plant that grows on the islands in the sea, they discovered that by grafting this plant, "Hai-tao" cotton onto a dwarf form of cotton plant, "Pa-wang-pien," the seed progeny produced after this "training" was a dwarf form of cotton plant.

Ever since the opening of the East China Agricultural Research Institute in 1950, the grafting of "Lu-ti-mien [cotton] Tai" No 14 onto "Hai-tao-mien" was practiced. The flowers on the graft bloomed a month earlier than usual. In the F1 generation of this seed progeny the flowers bloomed about one month earlier than the flowers on the graft. However, when the F1 generation was "trained" a second time, flowering occurred four days ahead of the F1 generation. The Institute was also able to cultivate fibers 40 millimeters in length from the seed of this F2 generation. This variety of cotton crop ripens during the same period as the new hybrid, "Ch'ang-jung" No 3, which had been bred from the "Hai-tao-mien."

The [Liaoning] Feng-ch'eng Agricultural Experimental Station grafted the late ripening soybean "Hsiao-pai-mei" onto "Man-ts'ang-chin," an early ripening plant. The resulting progeny were able to ripen 10 days earlier, and the plant was transformed into an intermediate type, bearing on its stem the intermediate characteristics of both parent plants.

From 1952 to 1955 the Kwangsi Agricultural College grafted the white-flowered "Wei-ts'ai" onto a sweet potato plant. There were great changes in the F2 generation and qualities not present in the parent plants appeared.

For instance, the leaves were round in shape or resembled butterflies; other leaves came in clusters of three, etc. This hybrid plant sprouted luxuriantly and grew very fast. The size of the leaves and the thickness of the stalk were 1.75 times greater than the original parent plants.

HUANG Liang-wei also did research work at the above mentioned college. By vegetative hybridization seed progeny from two kinds of sweet potato were cultivated, and a new variety of sweet potato was produced. This hybrid sweet potato was highly resistant to potato blight and was given the name of "Kuei-nung" No 1. HUANG Tso-chieh and others trained the "Sheng-li" No 1 sweet potato onto young potato plants five times in succession until the seed progeny were finally able to take on the special quality, inherently found in young potato plants, of directly bearing tubers on the roots of the plant.

The Institute of Pomology, China Academy of Agricultural Sciences, trained and grafted the "Kuo-kuang" apple (a variety which is late-bearing and keeps well when stored but which is neither fragrant nor beautiful) onto the "Yuan-shui" apple (a variety which is both fragrant and beautiful, but not good for storage). In this case a bud was taken from the "Kuo-kuang" and grafted onto the "Yuan-shui". This training resulted in the new variety "Kuo-shui", which is both fragrant and gorgeous in color and at the same time will store well. This variety developed into one of those rare types which produce excellent quality seed and ripen late in the season. Cross pollination had been previously attempted, but no hybrids were produced which could pass on all the good qualities of the parent plants.

MA Hsi-hsien of the Nan-ch'ang Normal School experimented with fowl. A hybrid chicken was produced by the mutual exchange of egg whites in eggs from different species of fowl. Not only did the chicken have a large head, long neck, broad breast, but it had web-like feet which were large and thick and the body was quite heavy. It also exhibited other characteristics similar to a goose. It was resistant to cold, developed fast and was very vigorous.

YU Hsien-chueh and others at Wu-han University experimented with the cross breeding of different species of fowl, such as turkey, chicken, and duck. Cross breeding chicken and turkeys has produced very obvious changes in the variety of fowl hatched from this union. A very vigorous type of hybrid was produced after TING Shu-po

used this method of exchanging egg whites at Fukien University.

CHAO Hsi-ping of Peking Agricultural University injected the egg white of the Peking duck into the egg of an Australian black chicken. The egg white of the Peking duck or of the China goose was also injected into the egg of the "Lo-tao-hung" chicken and that of the "Hsin-i-hsien" chicken. Hybrid fowls with shorter incubation periods were produced. These fowls develop rapidly and are large and heavy while they are still young.

CHANG Chien-shih and others at the Biology Department of Northwestern University experimented in the transfusion of blood as a means of cross breeding different varieties of chicken. "Yu," "Lai-hang" [leghorn?] and Australian black chicken were used in the experiment. Hybrid chickens were produced through the mutual transfusion of blood in the different varieties, and an immediate change was noticed in the hybrids.

For instance, the average weight of a "Lai-hang" egg is 46.92 grams, but after transfusion the average weight was increased to 54.14 grams, showing an increase of 15 percent. In general, the shell of the "Yu" chicken egg is flesh colored and that of the Australian black an earthy brown; but after these two varieties of chicken were transfused with the blood of the "Lai-hang" chicken, the color of the egg shells gradually became lighter until finally they were the same color as the "Lai-hang" chicken egg. The opposite happened when the blood of the "Yu" or of the Australian black chicken was transfused to the "Lai-hang" chicken; the color of the egg shells then gradually became flesh or earthy brown.

When a hybrid chicken, produced asexually is mated with a cock of the same species, considerable changes will be noticed in the F1 progeny. The body weight of the chicken will increase by 30 percent; it is more vigorous and develops faster; the body is longer and broader; the ratio of hatched chickens and the viability of the hatched chickens increased by 24-46 percent; red corpuscles and hemoglobin content in the blood is increased; and the chicken is more resistant to diarrhea and the "Hsin-cheng" [Newcastle's] epidemic. The changes in the F2 generation of hybrid chickens were much greater than the F1 generation, and the F3 became gradually a more stabilized type. Such hybrid chickens lay eggs throughout the year, never resting in the summer or winter months. It was observed that these hybrids

developed a tendency to increase female characteristics during subsequent generations.

T'UNG Yun-hsü of Lan-chou University has made clear the results of his experiments in the transfusion of blood as a means of crossbreeding. He demonstrated that egg laying could be increased by the transfusion of blood from a "Lai-hang" rooster into the blood stream of a "Shou-kuang" hen. The egg laying pattern was closely observed 2-3 months before transfusion and 4-6 months during the period of transfusion. In comparison with a control chicken it was found that chickens which had undergone transfusion laid twice as many eggs as the control chickens. The color of the egg shells was also affected by the transfusion and other changes were observed.

From the examples given above we are able to observe that there was no union of the parent cells during this type of asexual cross breeding, and therefore, it was impossible that the changes which had occurred in the chickens were developed as a result of the mating of a "basic substance" within the cells of the parental bodies; and yet, notwithstanding all this, a true hybrid chicken was produced.

We can see from all these examples that asexual crossbreeding is but an interchange of nutrient materials between the two parents concerned. An exchange of egg white or the transfusion of blood from one chicken to another can also be the means of producing hybrids. Therefore, it is unnecessary to have a so-called "hereditary substance" to effect changes, for changes can be produced by predetermined direction.

The Michurin theory accepts the fact that any living substance within an organism, be it in the organ, cell, or the microscopic speck in the cell of the organism carries the property of heredity. This basic point in the Michurin theory has been gloriously proven by the increasing amount of research material submitted on the subjected of asexual crossbreeding.

(3) <u>Research on Predetermined Cultivation</u>

Any modification in a living organism has been acquired through changes in the conditions of living. Changes acquired through sexual or asexual crossbreeding are merely an indirect form of change in the conditions

of living. Therefore Michurin's theory of changing the living conditions views this action as the basic cause of the modification of a living organism. Men will merely have to learn how to control the changes in the environment to be able to modify the metabolic processes in animal and plant life so that changes in the hereditary nature of living organisms may be developed in a predetermined direction. The nature of change is but a response to the action of external environmental conditions during the early developmental stages of the organism.

Morgan's school of thought affirms that modification in an organism is due to the sudden change in a basic substance within the organism. External environmental conditions have been merely looked upon as an "inducing action". Morgan firmly believes that any modification of the organism is a change which has occurred from within the basic substance of the organism iteelf and is not of a predetermined nature.

Therefore this problem is still a matter of controversy. However, results culled from the vast amount of research material have proved the accuracy of this particular viewpoint in Michurin's theory.

CHOU K'o-k'uan and other research workers at the Northeast Agricultural Research Institute experimented during the years of 1949 to 1955 with the transformation of spring wheat into winter wheat and based their research work on the Lysenko theory. By 1955 there were already seven varieties of winter wheat seed and 14 varieties of wheat seed which had acquired some of the characteristics of winter wheat.

Later, research workers transformed a hard-seeded wheat variety and a black wheat variety into hardy winter wheat. Based on this research work it was found that when spring wheat seed was transformed into winter wheat, considerable changes were observed in the special characteristics of the wheat.

For instance: the leaves of the plant became shorter and narrower, and the color was much darker; soft hairs along the leaf edge disappeared; germination was dormant in the autumn sown seed; developmental changes were observed at the stalk tips, branch joints, and earing; and maturation was much earlier than the original spring wheat variety. The winter "K'o-hua" wheat variety produce one to two more ears on the stalk than the spring "K'o-hua" wheat variety, and each thousand-seed weight was increased by two to three grams.

It was also pointed out that when spring wheat is sown in late autumn, the hereditary nature of the wheat can be "shaken" [This means the disruption of the metabolic norm during development causing an increase in the adaptive capacity of the progeny in the direction of the inducing environmental factor.] The progeny of the seed can then be sown a little later than usual in the autumn of the second year, and under these conditions the wheat will be transformed into a winter form.

It was also observed that when different varieties of spring wheat seed were transformed into winter wheat seed there were variations in the kind of transformation in each variety of wheat seed and therefore there were different degrees of winter hardiness in the various types of wheat seed. Repeated sowing of this modified wheat seed during the autumn season will gradually increase the tendency of the seed towards the winter form and increase the winter hardiness of the wheat.

After winter hardiness has been established in the wheat, there will still be a difference in the degree of winter hardiness in the body of the individual plant, in the individual ears of each plant, and in the individual seed from each ear. These conditions demonstrate Lysenko's theory that nutrient materials produced and stored by the germinating buds during early autumn while the temperature is still high will continue to supply nourishment to the stalk tip to further aid in the development and growth of the plant even after the temperature has been lowered. Therefore the growth and the development of the individual plants will differ from each other in the degree of winter hardiness or spring form as there is a difference in the nature of their inheritance. This is the reason why there are so many varieties in the progency of the seed.

CHEN Yen-ts'ai carried out experiments at the Inner Mongolian Agricultural Research Institute in Hu-ho-hao-t'e during 1953-1956 on the transformation of spring wheat into winter wheat. CHEN demonstrated that the white-grained "Pi-k'o-ch'i" wheat can be converted from a spring form into a winter form. The same law was observed by LI Fan and other reserach workers at the Laboratory of Genetics, Academia Sinica.

FANG Hsin-fang did research work on microbiology at the Institute of Microbiology, Academia Sinica. In searching for a yeast capable of fermentation at high temperatures to produce alcohol, he cultivated ordinary yeast and subjected it to high temperature conditioning

for several generations, until the yeast gradually became accustomed to high temperatures. A relatively high ratio of yeast spores died during the first few generations, but gradually the yeast spores were modified to withstand high temperatures.

Later, a comparison was made of the physiological differences found in this new variety of yeast and in the ordinary yeast; it was definitely established that this new variety, never before discovered, could withstand high temperatures.

Research was also carried out by FANG on the gradual addition of sodium flouride in the nutrient fluid of yeast cultures. The yeast gradually acquired resistance towards sodium flouride and was able to propagate and cause fermentation in the lees of wine or in spirits containing large amounts of sodium flouride.

During 1953-1958, FANG and other research workers also carried out experiments on the cultivation of cotton at low temperatures. Seeds which had already germinated were passed through the vernalization phase for several days. When vernalization was discontinued, the temperature was artificially decreased or decreased by sowing the seed early in the season.

Thereafter, the seed was sown each year in the early spring. The seed progeny of the F3 generation was modified into a short or dwarf form of cotton plant. The results were the same even after the second and third trials. However, seed taken from the same source and successively sown for three years in the latter part of the year, were not transformed into dwarf cotton plants, but after being conditioned to a low temperature for several years, the young plants were able to increase their resistance to frost. This also enabled the plants to put forth sprouts at an earlier period.

CHIANG K'o-ming experimented on the cultivation of cotton at low temperatures at the Shensi branch of the Chian Academy of Agricultural Sciences from 1954-1958. His results proved that by continuously cultivating cotton at low temperatures every year, he was able to decrease the required temperature for germination and increase frost resistance of the cotton plant. The body of the plant became firm and compact and showed a tendency to mature early. Seed of economic crop value was thus selected for planting. From comparable experiments conducted by the Shansi Agricultural Research Institute a new variety of excellent seed was selected for planting economic crops.

HU Ch'i-te of the Laboratory of Genetics, Academia Sinica, performed experiments during 1951-1959 on the crossbreeding of a winter form and a branching form of spring wheat. A hybrid wheat was developed, and the seed from this hybrid was sown in the autumn in successive years. Shoots from the plants were discarded, and the ratio of nitrogen, phosphorous and potassium compounds added to the soil was controlled and checked during the various stages of the plant's development so that during the period of earing the rate of plant growth could be increased and the maturation of the plant delayed. All this was done in accordance with the principles and methods of Michurin. An excellent branching form of wheat with an established type of ear, an erect stalk and high quality white-grained seed, both hard and translucent was produced. No extra protection was needed to keep the wheat from freezing when planted in Peiping, for it was a hardy winter type.

In comparing this hybrid wheat with the local wheat "Hua-pei" No 672, it was found that an average of 117.1 grains were harvested from the main ear of each plant in contrast to the 67.9 grains collected from the local wheat. The hybrid grain weighed 3.3 grams for every thousand grains, and the local wheat weighed 2.2 grams. There is great hope that a high-yielding type of new seed will be developed from this hybrid.

TING Chen-ling and WANG Li-ch'uan of the Chekiang University Agricultural College experimented in the transplantation of the "Erh-ling" barley from Hangchow. This developed a larger root, increased the size of the leaves and the assimilation and production of nutrients, and resulted in the formation of a branched type of ear. During 1952-1954 the Northwest Agricultural Research Institute carried out transplantation of the "Hsi-nung" No 6028 wheat and was also able to produce a branched-ear type of wheat.

During 1953-1956, YEN Chi also experimented with the transplantation method at the Szechwan Agricultural College. By transplanting 20-odd samples he was able to cultivate 10 varieties of branching wheat and three varieties of branching barley. Two varieties each of branching wheat and barley were selected for further cultivation, as these varieties had exhibited a fixed tendency towards branching. An average of 260 grains could be harvested from the main ear of each wheat plant; moroever, the grains were greatly increased in size. Coarse protein nutrients were increased from

14 to 17 percent. Stalks were much thicker and more disease resistant.

During 1950-1955, T'IEN Shu-min of the Central China Agricultural College applied the Michurin theory and methods in carrying out preliminary experimentation on the "training" of apples under certain climatic conditions. According to previous experimentation by other research workers, apples require an average temperature below 26 degrees centigrade (June to August) to be cultivated. Yet the average temperature in Wu-ch'ang and Hankow during the same months was 27.9 degrees centigrade, so that it is difficult to transplant or graft apple trees originating in Chefoo (Yen-t'ai).

T'IEN cultivated the apple seed until it started to germinate and developed it under the very best of environmental conditions. The results were successful. This demonstration further proved that germinating seed plants can be easily grown in rich soil and can be easily cultivated towards a desired type. In barren soil they could just as easily revert to their former wild type. For several years in a row, a solution of cane sugar was injected under the bark in the main trunk of the apple tree so that it would be possible to increase the sugar content of the fruit. In this way, a new variety of dwarf apple tree "Wo-chin Shih-sheng-miao" No 1 was developed, and its apples were sweeter than other varieties.

(4) Research on Intra-varietal Crossing and Vigour

Intra-varietal crossing is the most common method used for the selection of seed, but it should only be carried out with the principles and the exact theories in mind so that proper results can be manifested. If the process of hybridization can be reasonably be explained as the union of the "basic substances" from the two parents and as a process of predetermined separation after free "mating," then it is wrong to say that mankind can only carry out selection and cannot carry out predetermination.

The Michurin theory points out that to control development in the hybrid to produce new varieties, it is only necessary to be skillful in selecting parental stock and in carrying out the predetermined cultivation of the hybrid's progeny.

When the principles and methods of Michurin's theory are properly carried out, the function of intravarietal crossing will be considerably increased.

During 1951-1959, YANG Chin-hui and other research workers at the Institute of Pomology, China Academy of Agricultural Sciences, applied Michurin's theory to the cultivation of frost-resistant grapes and good results were reported. [Wild] grapes from the hills and domesticated grapes were crossed, producing a progeny able, at the start of the second year, to be conditioned to withstand cold.

At present the "Hei-shan," "Shan-mei-kuei," and other new varieties have been developed to be frost-resistant at -26 degrees centigrade. These new varieties are now being cultivated experimentally in the northern regions of the country.

In summarizing the experiments as a whole, it was found that when "training" was attempted at low temperatures, controlled development in the plant was made possible during the period of germination. In the method of "layering" branches and creepers [tendrils] are pressed into the earth and covered with layers of earth, leaving a few hardy sprouts above ground, and by increasing the phosphorous, potassium and other minerals in the fertilizer, it was possible, finally, to produce a frost-resistant grape vine which otherwise would not have been possible.

HSU Nai-yü of Wuhan University did research work during 1956-1958 on the development of hybrids. He used four varieties of peas as material in his research on the effects of various fertilization methods and environmental conditions in the development of hybrids. The white and red flowered peas were crossed by artificial pollination using paternal pollen which had been stored for nien days, and the resulting F1 generation produced white flowers.

This was an indication that the recessive characteristic in the maternal stock had become dominant. However, when fresh pollen was used, the character of the paternal stock was dominant. It was also observed that hybrids cultivated under different environmental conditions developed characteristics which were also variable.

HSU Wei-ying of the Institute of Forest Research experimented with different varieties of willows. First, the Tsuan-t'ien [ordinary willow] was used as the maternal stock and crossed with the green willow (Ch'ing-liu); then the small-leafed willow (Hsiao-yeh liu) was used as

the maternal stock and was crossed with the Tsuan-t'ien willow. Each cross developed an intermediate type of willow, the Peiping willow and the Ho-tso [cooperative] willow respectively. These hybrids were frost-resistant, hardier than the parent trees, and grew much faster.

In another experiment the willow was crossed with an aspen (yang) by means of grafting. Different ways of union were tried and itw as discovered that the best way to unite the two species was to use the Han willow, the maternal parent, as the stock, and the Tsuan-t'ien willow, the paternal parent, as the mentor. A small piece of the Tsuan-t'ien willow together with its sap was grafted onto the stock. Later, after the graft had taken, it was pollinated with the pollen taken from the paternal parent (Tsuan-t'ien willow). The results were very good. The 16 young saplings developed by this method had a much faster rate of growth than the Han willow. Therefore, it was acknowledged that Michurin's "stock mentor" method had overcome the sterility existing between different species of trees which were being hybridized.

The Institute of Animal Husbandry and Veterinary Medicine, Lan-chou, has cooperated with the Northwest Animal Husbandry and Veterinary Medicine College to develop a new species of sheep which would be better adapted to the region of Tsinghai and which would produce a better quality of wool and mutton.

A coarse-haired Tibetan sheep was used as the maternal line and it was crossed with two other species of sheep, the fine-wooled Caucasian sheep and the fine-wooled Sinkiang sheep. In the F2 progeny, the wool produced by the rams was increased to 4.67 kilograms (the wool produced by the Tibetan sheep was only 1.48 kilograms) and it was as fine as sixty strand untwisted cotton thread.

It was also pointed out that there is a close relationship between the age of the parents and the inheritance of dominant or recessive hereditary characteristics from both parents. Therefore, in order to have more of the good qualities of the paternal parent transmitted to the hybrid animal, the ram must be older than the ewe. Under reverse conditions most of the hybrids will inherit the maternal parents dominant characteristics, and in Tibetan sheep the dominant characteristic is its hardiness. This is a quality which can be readily transmitted.

WANG P'i-chien of the Kwangsi Agricultural College experimented in the breeding of cattle. The common yellow cattle, used as the material strain or line, was crossed with a short-horned cattle species from Holland and with two other unspecified species. By 1952 a number of hybrid cattle were bred from the union of these four species. After five years of careful feeding and care, the hybrid cattle developed exceptionally well.

Within this herd of hybrid cattle were two cows which produced the largest volume of milk. During the second milking period on 5 May 1959, the record for milk production was broken with a record 61.5 shih-chin of milk producd. It is believed that a good hybrid stock bred from the common yellow cattle of China, if given the proper type of nourishing food, will be able to develop into high milk producing cows.

The inter-varietal and intra-varietal crossing encountered in the work of rejuvenation is a measure for overcoming regression in a species. All related unit organizations in the whole country have already done much research on this subject.

During 1954-1958, CHAO Yu-sheng and other research workers studied the selective fertilization of wheat at the North China Agricultural Research Institute. From the results of their research work they acknowledged that in order to increase vegetative vigour and production yield in wheat varieties, it would be better to have free inter-pollination between different wheat varieties. This method is especially successful when the maternal type has been previously emasculated [sic, ch'ü-hsiung] and pollinated or fertilized afterwards.

The "Yen-ta" 1885 and the northern strain of wheat "Pei-hsi" No 4 were used as examples in this research and they were not emasculated for the experiment. The yield from the progeny of the F3 generation was increased 5-18.8 percent over the control group. In the emasculated grain taken from the above two samples, the yield was 28 percent above that of the control group. In the rejuvenation process the progeny rarely differs from the maternal type and can therefore maintain the original maternal type.

WANG Chung-yen and HUANG Ch'ao-wu experimented with the intra-varietal crossing of seven varieties of rice at the South China Agricultural College during 1950-1951. They found that the average yield was increased 16.31 percent and the average thousand-grain weight was increased 12.29 percent. In a separate

experiment the pollen taken from four varieties of rice were mixed together and used in intra-varietal pollination. This method increased yields 3.5-20.7 percent.

CHEN Nan-k'ai of the Northeast Agricultural Research Institute did some experiments on the effects of intra-varietal crossing and rejuvenation and on the length of time in which rejuvenation could be maintained in the hybrid stock. For instance there is a great variety of types, and since each type is different the effects of rejuvenation and of intra-varietal crossing in each type will be different. In some the effects of rejuvenation wear off during the F2 and F3 generations; in others the effects may last longer. For example, the yield from the F2 progeny of the "Hsing-ya" type is 9.2 percent greater than the control group; the F3 progeny is 5.2 percent greater and in the F4 progeny the yield is still increased 6.1 percent [over the control group].

CHOU Chih-chen of the Laboratory of Genetics, Academia Sinica, and TAI Fang-lan of the Northeast Agricultural Research Institute cooperated in their experimental work on cotton during the years 1953-1957. In their research work on cotton they carried out intra-varietal crossing by mixing the pollen collected from many varieties of cotton and fertilizing the maternal type "Ssu 2B" with this mixture. The results showed that the F1 generation matured earlier, that the yield was considerably increased in each plant, that emasculated maternal types were much superior to those which were not emasculated, and that twice fertilizing the maternal type with the pollen mixture was more effective than fertilizing it once.

They observed that the results of rejuvenation could be maintained for four generations and certified that the increased yield in cotton production would be above 4 percent. Later generations show a slight difference in their characteristic when compared with the maternal type; but the most important characteristic in the maternal type, its economic nature, is maintained.

WANG Chien and CHU Chien-mu of the Hopeh Agricultural College experimented during 1953-1955 on changing the external environmental conditions of plant life as a means of increasing vegetative vigour. Corn, various types of millet, and other sorghum plants usually sown during spring were sown in different intervals during the winter season. It was discovered that the seeds germinated earlier than the control seed which had been

sown in the spring. The germinating bud was large, grew fast, ear formation was earlier by five to seven days, and the yield of grain was increased. Such plants as "Su-ta-mao-huang," and "Hua-nung" No 4 increased 10-16 percent in yield when compared with the controls. The progeny of the winter form grain which had been sown in spring was disease-resistant and showed other effects of rejuvenation.

Rejuvenation by means of winter sowing is historically recorded in the ancient agricultural books of China. TU Chu-ming of the Shansi Agricultural College based his research work on rejuvenation on the ancient "Methods of Sowing Grain in Winter (Tung-yueh Chung-ku-fa). His research proved beyond any doubt the accuracy of the ancient Chinese records on agriculture.

He proved that sowing seed in winter would promote earlier germination and consequently earlier maturation of the plant. This would be about 21-25 days earlier than usual. It was observed that the grain which was sown in winter developed greater winter-hardiness. Increased crop yield and increased resistance towards disease was also noted. The ratio of rice yield became five to seven percent greater, and the amount of protein within the plant itself increased by three to four percent.

According to the material gathered by research workers, the advance that have been made within the past few years in agriculture have been due to the strict application of the rejuvenation method. This method has greatly increased the yield of grain and has been attempted on large areas of land in Kansu Province. The area of San-chiao-cheng Hsiang, in Yü-chung Hsien, Kansu Province, has increased the yield of its crops by 30-45 percent. In Wa-yao Hsiang, An-chai Hsien, Shensi Province, there was an increase of 22 percent, and 30-50 percent in T'ai-ku, Chi Hsien and T'ai-yuan, Shansi Province. The average yield on 460 mou of land in Kao-p'ing Hsien was increased by 30 percent when compared to the yield of the crops sown in the spring. Last winter, over 300,000 mou of land was used for sowing winter grain in Shansi alone.

(5) Achievements of Farmer Scientists

Since the liberation the desire and enthusiasm of the broad farm masses to increase agricultural

productivity and to learn how to increase production has been brought to an unprecedented high tide. This is especially so, since agricultural collectivization and since the people's communes were established. These measures opened up a path in scientific research work for the farmers.

The communes have established "Red and Expert" schools and experimental farms and some have even established research organizations. The broad farming masses have combined their work in production so that they would be able to carry out all kinds of experiments and solve the many different kinds of problems in agricultural technique.

Many model farmers have achieved good results in their work and have been especially assigned to work in professional research institutions. Personnel of this type are innumerable and their future in the army of technicians is very great because their contribution in the promotion of socialist construction work and in professional research organizations is increasingly manifest.

The broad farming masses welcome the Michurin theory and many areas have organized small groups on their own to study Michurin's theory and to carry out experiments. Even the Young Pioneers have organized "Michurin Youth Farms," etc. Much has been accomplished by these people during the past decade.

A young farmer, TENG Yen-t'ang from Hsin-huei in Kwangtung Province, has carried out experiments since 1953 on the development and the cultivation of rice. He followed in Michurin's footsteps by carrying out intra-varietal pollination, repeated pollination, and many other methods of fertilization. A great number of hybrids were produced from these experiments. "Kuei-feng" No 1, No 2, and No 3 were considered his best efforts.

Besides experimenting with inter-varietal and intra-varietal crossing, he also crossed different species. "Kuei-feng" No 3 is a hybrid developed by crossing "Nan-t'e-hao" and "Kuang-ch'ang" No 13. He then mixed together the pollen of maize, kaoliang [sorghum], tares, and "dog-tail grass" (Kou-wei-ts'ao) and carried out fertilization of rice to develop new hybrid types.

A new type of hybrid rice was developed by grafting the rice plant into kaoliang. This hybrid matured early, produced an increased yield, had large ears and a robust stalk, grew vigorously, and had the same superior characteristics of a small kaoliang plant. Later, TENG

USED THE "Kuei-feng" No 3 as the maternal type and millet or "su" [maize] as the paternal type and crossed these two different species of cereals. A hybrid with exceptionally large ears was produced from this union, and an average of 400 grains could be gathered from each ear of rice.

Some of the larger ears of rice would even have 600 grains. The stalk was robust, and the plant was dwarf-sized. These were some of the many superior qualities the hybrid rice interited. At present this kind of successful research work is being carried out on a large scale on experimental farms established in the people's communes.

CHOU Han-hua, a young farmer, has been experimenting since 1953; and according to reports from the Kwangtung Agricultural Bulletin, has been highly successful. He based his experiments on Michurin's method of selective cultivation and developed one after another 18 different new varieties and new seeds. The five best varieties were "Ma-shan-li-ta," "Hsin-chan," "Hsin-nung-chan", "Ai-pai-chan," and "Hsin-fu-chan."

These five new varieties were then used as the maternal type and the "Ho-shan-ai-chiao" kaoliang was used as the paternal type. Intra-species crossing was carried out. The progeny had large roots, matured 10 days earlier, and had a robust stalk and ears 8-10 inches in length, each large ear contained about 408 grains. The tip of the main stalk was entirely free from leaves. The stalk was so robust that very few of the plants were blown down by typhoons during the earing and flowering period. There is hope that a new and superior quality seed will be developed.

CHIANG Shao-fang of Kwangsi used rice as the maternal type and fertilized it with kaoliang pollen, and a new seed variety, "Yu-shih" No 1, was selected from among the progeny of this union. After "Yu-shih" No 1 was crossed with the original rice type, two new seed varieties, "Yü-shih" No 2 and "Yü-shih" No 3, were produced.

According to this research the selective developmental conditions under which the plant was cultivated performed a most important function. For instance, during this period of selective cultivation the "Yü-shih" No 1 had to go through the process of autumn sowing so that it would be able to take on the characteristic of a hardy winter plant of withstanding low termperatures. It was then able to flower and turn to seed at 10 degrees centigrade.

Normally it would need a temperature of about 17-18 degrees centigrade. This new variety of rice is able to grow and develop at zero degrees centigrade.

At the Kao-feng People's Commune the farmers had excellent results in crossbreeding the common yellow cattle with water buffalo. In the past few years 21 hybrid cattle have been bred and the people's commune has widely adopted this method of crossbreeding. For instance, the "Chung-yin-tzu" water buffalo cow was mated to a yellow cattle bull for three years in succession and three hybrid cattle were born. The special features characterizing this type of hybrid cattle are its similarity to the general appearance of the water buffalo with its retention at the same time of many of the characteristics of the yellow cattle.

For instance, its head resembles the water buffalo, but its horns are like the yellow cattle; its fur is thick and long, and the tips of its hair is reddish or yellowish-brown in color. Its tail is longer than that of the yellow cattle, but its udeers are larger then the water buffalo. The gestation period is shorter than the water buffalo.

The F2 progeny of the hybrid cattle are greyish-yellow or yellowish-brown in color. They have big bodies and are very lively and healthy. Hybrid cattles are superior in their ploughing ability; their great lung power capacity and greater ability to withstand heat stand in contrast to water buffalo, which pant for breath during the warm weather and have to drink and take baths frequently to counteract the heat.

Hybrid cattle do not need to eat, drink, or take baths as frequently as the water buffalo. Their food consumption is less yet they have greater strength in pulling than the water buffalo. The water buffalo can only plough four to five mou of land each day in contrast to the six to eight mou of land ploughed by the hybrid cattle. In addition, hybrid cattles are agile in mountain climbing, are disease-resistant, and are able to adapt to long periods of ploughing very easily.

The farmers of Chung-hsing Hsiang and Shih-yang Hsiang in Hua-yang Hsien, Szechwan Province, have also crossbred water buffalo and yellow cattle. They were equally successful in breeding hybrids, achieving the same superior qualities as those of the hybrids mentioned in the preceding paragraphs.

LIU Chih-p'ing of Lien-hsi Hsiang, Yun-lien Hsien, Szechwan Province, produced a hybrid cattle by cross-

breeding a yellow cattle bull with a brownish-black water buffalo cow. This hybrid had the outward appearance of the water buffalo, but its hide was reddish-yellow like the yellow cattle. However, the hybrid is much more powerful than the yellow cattle and more intelligent than the water buffalo and is especially suited to plough in the hilly regions of Szechwan.

Yunnan and Kweichow provinces were also successful in this method of crossbreeding, and it has been generally adopted by all the farmers. This has greatly aroused the attention of the technical world to the importance of this method of animal breeding.

Predetermined directional development of plants has been the subject of research for LI Shao-hsien of P'ing-shang Hsiang, Ting-hsien, Kweichow Province. He selected seeds from the tip of an ear of corn that had a slight tendency to fork and planted the seeds in fertile soil, frequently adding different kinds of fertilizers to further enrich the soil. These plants were very carefully cultivated, and by 1955 a new variety of corn was produced. Three to four ears of corn grew from one forked ear. Some ears had as many as eight forks of ear growing from it. These forked ears of corn were usually over a chin in weight.

Besides this, there were many instances of excellent results reported on experiments made with wheat, rice and cotton which were grown from selected seed sown by the farmers. For instances, the farmers of Lin-ch'ing Hsien, Shantung Province, developed a cotton plant, the "Lin-ch'ing Ta-ling," a new variety which is especially large in size and produces more cotton. Each cotton boll weighs over eight grams, and the largest may weigh over 11 grams. Farmers from Lin-chang, Honan Province, have also developed a new variety of cotton plant, with each stem developing several cotton bolls.

CHEN Yung-k'ang of Kiangsu Province, developed his own variety of superior rice seed by his own method of selecting seed. WANG Pao-ching of Shensi Province is now carrying out experimental development on new varieties of crops cultivated from different species. The farmers of Fukien and Kwangtung provinces have experimented with the rejuvenation of peanut plants by reversing the sowing time of peanuts from autumn to spring, and the rejuvenation of rice by reversing the sowing of rice from spring to autumn, etc. Very good results have been achieved with these methods of rejuvenation.

From the above it can be seen that it is not enough for us to have achieved this kind of success in our research, but that there still are many faults which should be corrected. Such faults as poor organization and lack of dept in the nature of research work should be improved.

Besides this, our work in research has far from fulfilled the requirements of construction and cannot catch up with the development of our country's production enterprises. Therefore, it is necessary, under these circumstances, to whip up enthusiasm so that from now on a closer relationship with reality will serve to achieve more and better results in research work.

- END -